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The galactic stellar nucleation by globular cluster interactions in dwarf galaxies

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Abstract. Dynamical Friction Problem is a long-standing dilemma about globular clusters(hereafter,GCs) belonging to dwarf galaxies. The GCs are strongly affected by dynamical friction in dwarf galaxies, and presumed to fall into the galactic center. But GCs do exist in dwarf galaxies. Recently, a new solution was proposed. If dwarf galaxies have a cored dark matter halo, in which case the effect of dynamical friction will be weakened considerably, and GCs are able to survive beyond the age of the universe.

In this study, we discussed why does a constant density cored halo cease dynamical friction, by means of N-body simulations.

Introduction

Even in dwarf galaxies belonging to another cluster of galaxies, many GCs have been observed (Miller et al.1998). But, why these GCs can survive from strong dynamical friction is a long-standing puzzle. Read et al.2006(hereafter,R06), by N-body simulations, discovered that dynamical friction is weakened significantly if dwarf galaxies have a constant density core in its dark matter halo. They argue that the halo particles in constant density core become co-rotating with a GC, and thus the halo particles construct new equilibrium state including the GC. This equilibrium ceases dynamical friction, thus the GC can survive beyond the age of the universe.

But, the new equilibrium is very vulnerable to perturbation. If once the GC orbit is perturbed and the orbital plane is inclined, this equilibrium will be broken. And dynamical friction force on the GC is rejuvenated by perturbation in the orbital inclination. This fragile nature of the new equilibrium is also indicated in R06. In the paper of R06, they studied only single GC cases. But, of course, real dwarf galaxies don't necessarily have only one GC, but several or more. We expect that the orbits of GCs will be perturbed by gravity of other GCs. Then we anticipate that some GCs will fall into the galactic center and form a stellar nucleus.

Results & Conclusions

First, we carried out the same simulation as R06 in a constant density cored halo(Fig.1). We got the same result as R06. When the GC entered the central core region(from 200-300pc), the orbital shrinkage stopped.

Next, we examined 5GCs case and 30GCs case.(Fig.2 and Fig.3). In comparison with the single GC case, clearly GCs are perturbed by gravitational inter-

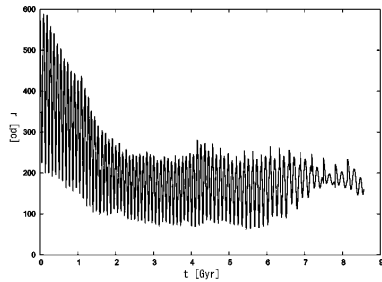


Figure 1. This is the same simulation as R06.

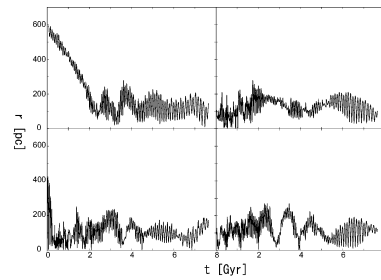


Figure 2. These are typical results of the 5 GCs case.

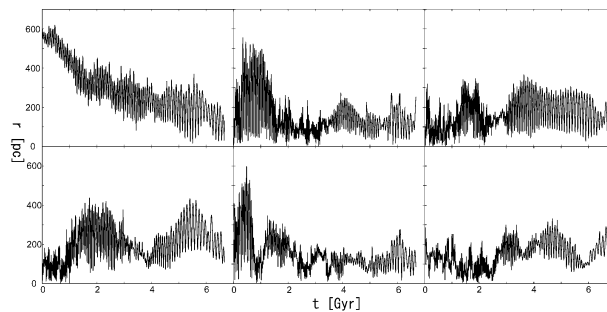


Figure 3. These are typical results of the 30 GCs case.

action. Regardless of the number of GCs, no GC fall into the center of galaxy. All GCs continue orbital motions in the constant density core region. This result is NOT consistent with our expectation or the statement of R06.

In this study, we confirmed that constant a density core ceases dynamical friction on GCs. This is consistent with the result of R06. But, even under the perturbation from other GCs, dynamical friction does NOT affect. This result is inconsistent with the insight of R06. We consider that this inconsistency is due to the misunderstanding about the mechanism for suppression of dynamical friction in R06(co-rotating equilibrium). A constant density core must have another reason of ceasing dynamical friction. We make a full report on this study in Inoue & Noguchi 2008(in preparation).

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References

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